iRIXS Operation Manual:

NOTE: If you are familiar with iRIXS and only need the spectrograph parameters *"**A Routine Procedure to Start RIXS experiments in iRXIS**" is provided on page **7** of this document.*

NOTE: Please check the "Important end-of-run operations" on page ***8.***

Beamline optics parameters for RIXS (focused spot) in iRIXS

V11 mirror:

- V11 bend up (axis-2): 5.34 mm
- V11 bend down (axis-3): 4.13 mm
- V11 translation: 0 mm

H1 switch yard horizontal mirror:

- H1 bend up (axis-2): 198.9 mi
- H1 bend down (axis-3): 240.987 mi
- H1 tilt angle (axis-1): 8.49641 mm
- H1 translation: 0.35 on scale

*Sample position in focus of both spectrographs **(Just an example):***

- Upper Stage, Center of sample holder, A starndard carbon-tape thickness:
- X =
- Y =
- Z =
- Rotation = 45^{o}

NOTE: These are settings of beamline optics for obtaining a focused beam with size of about 20um (vertical) X 100um (horizontal)

Locations and definitions

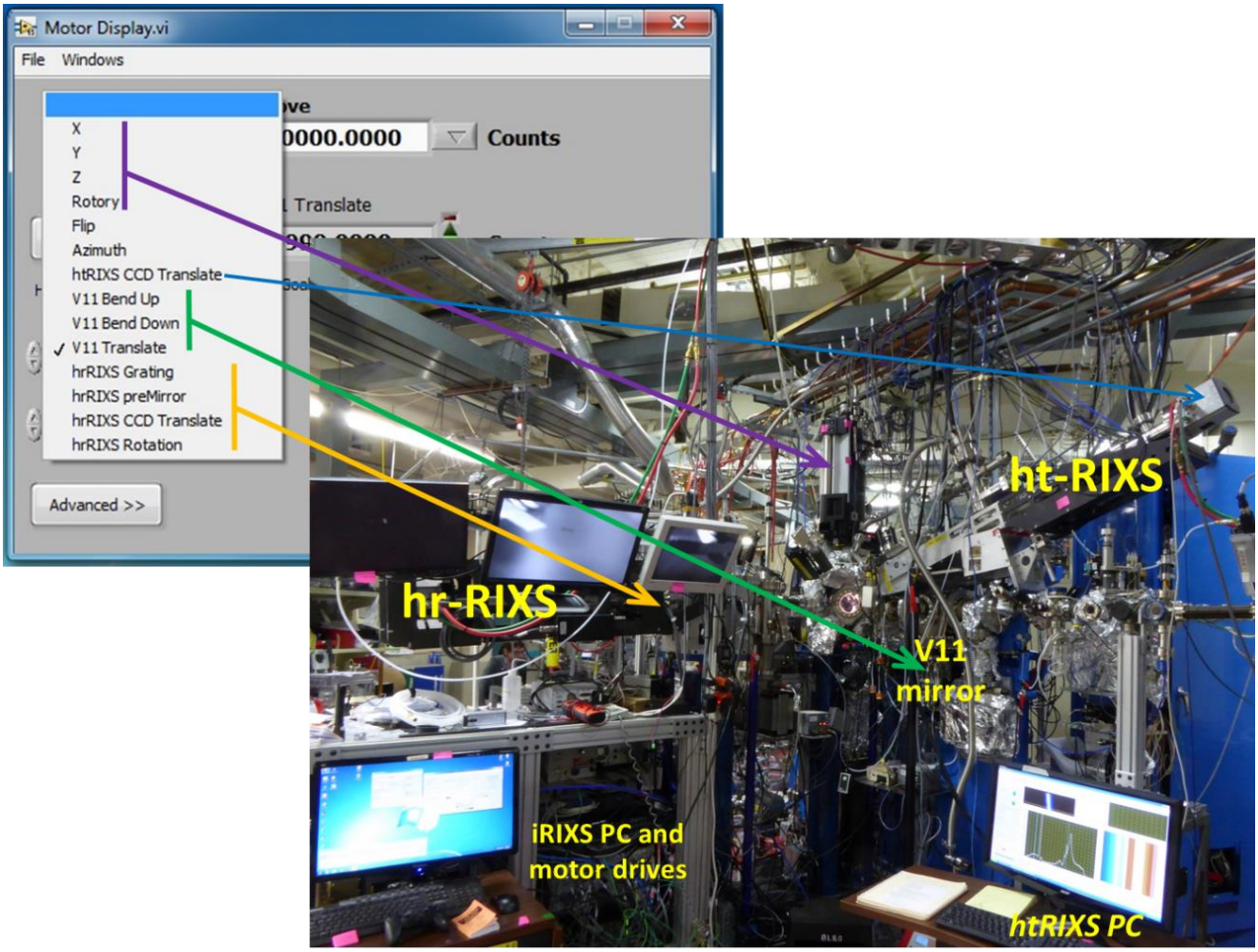
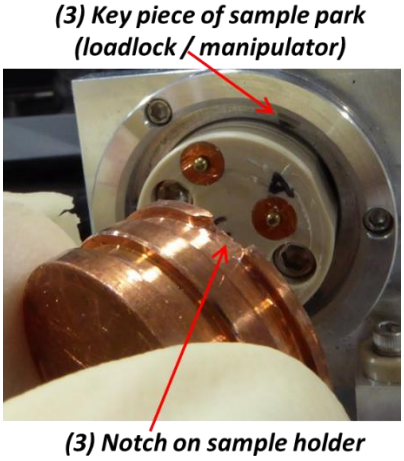


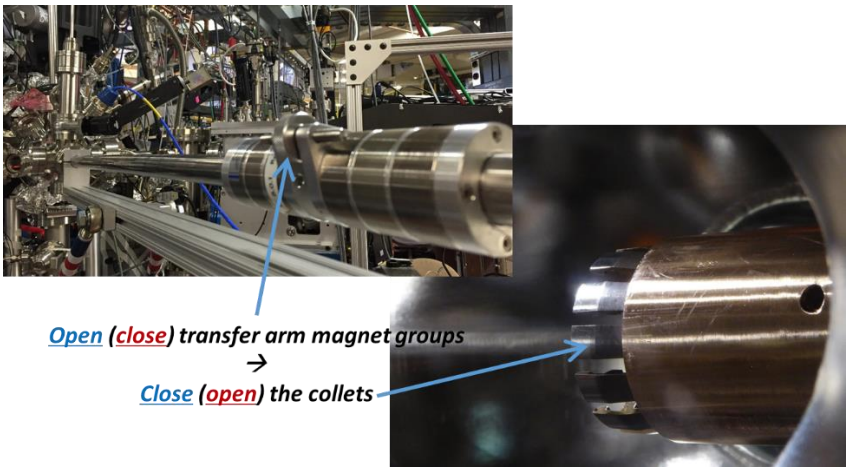
Figure 1: *motor names* in the iRIXS BCS software on the iRIXS main control PC, corresponding to the endstation components

As of Feb 2016, a 3rd computer dedicated for running Andor CCD software is provided (see below).

Sample transfer

Check out a high-definition video demonstration of sample transfer at http://bl8.lbl.gov/

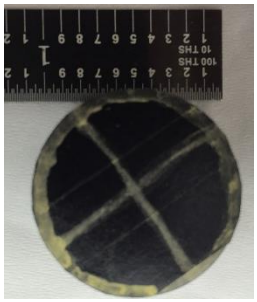




(left) The sample holder is locked into the sample parks in loadlock and manipulator by matching the 3 notches on the sample holder with the 3 pressing keys of the sample park, press the holder in and rotate about 10 degree, the sample holder will be locked in place tightly.

Note: Do not over rotate the sample holder once it's in place

(right) Close/open the collets of the transfer arm to grab/release the sample holder by open/close the transfer arm magnet groups. This is done by rotating the center wheel between the two magnet groups of the transfer arm outside vacuum chamber.



Note: Do not over-tighten the transfer arm collets

Note: Sample holders are of 1 inch diameter, but ***leave about 2mm edge*** area for the grabber collets. See image, attach samples ONLY to the black area!

High-throughput RIXS (ht-RIXS) spectrograph

The motorized items of ht-RIXS as of 2/22/2016:

- Low energy Mirror (in-vacuum picomotor) - VPB software in htRIXS PC
- High energy Mirror (in-vacuum picomotor) - VPB software in htRIXS PC
- Andor CCD translation stage (in/out) – iRIXS PC (see figure 1)

- All the LVDT read out and the (2) mirror in-vacuum motor controls are through the "VPB software" installed on the htRIXS PC right underneath the htRIXS spectrograph:
  - Channel 1 – high-energy premirror
  - Channel 2 – low-energy premirror
  - Channel 3 – Grating (both) – Note the grating rotation is not motorized
- Click the lightning button on the *VPB: closed-loop control* panel to move the motor!

Note: Motor motion has to be stopped by clicking the lightning button again, in order to display the LVDT readings on the main VPB panel!

The un-motorized items of ht-RIXS as of 2/22/2016:

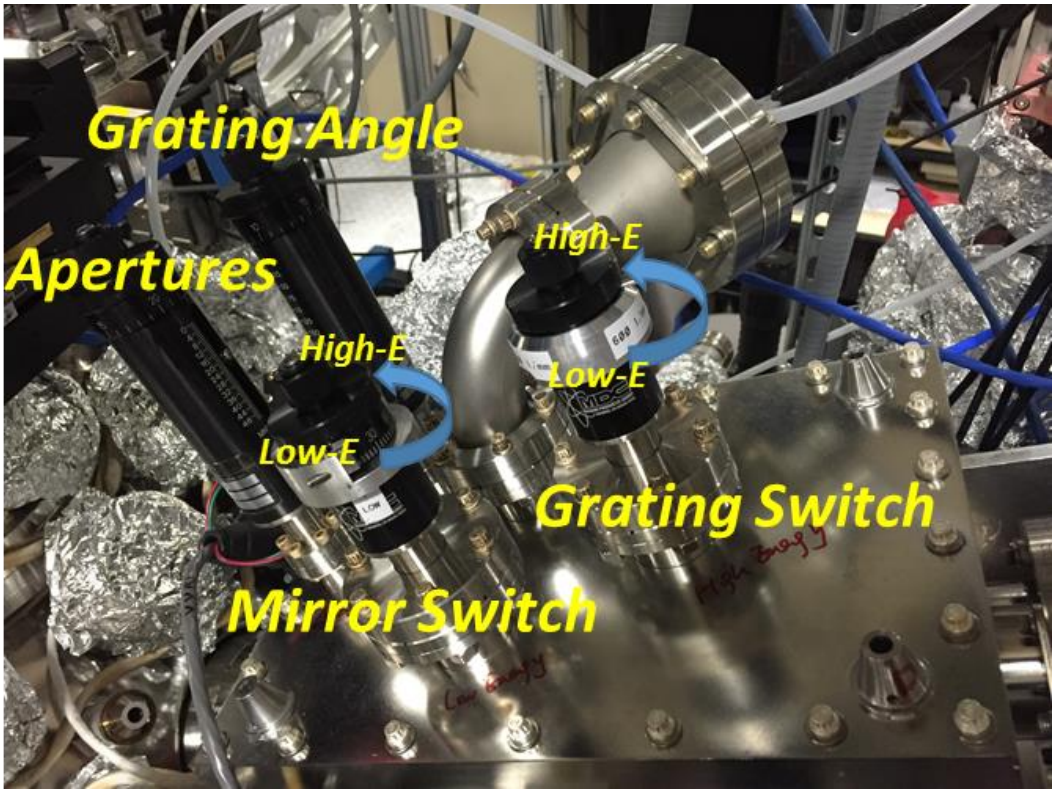
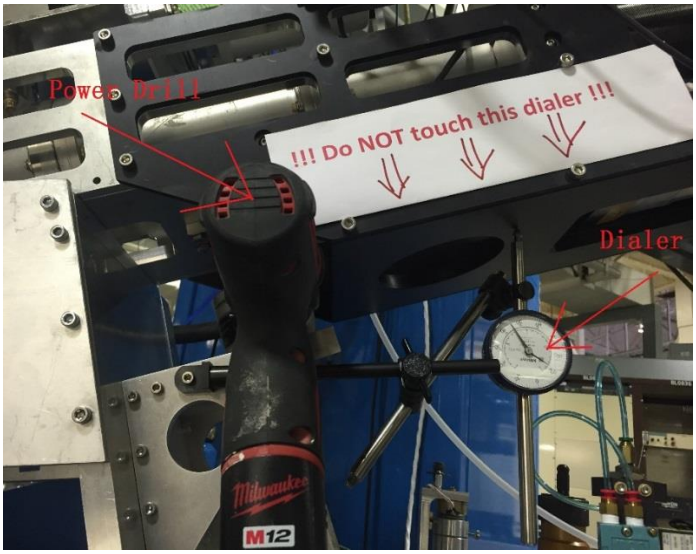


Figure 2: Manual adjustments of the optics in ht-RIXS spectrograph

- A plate with a series of **apertures** is installed upperstream of the spectrometer's optical table. The apertures are for alignment purpose, and ONLY if visible light needs to be blocked, a user could move the plate up/down by adjusting the Aperture-LMT.
- **Grating angle** is adjusted manually by turning the grating LMT and watching LVDT reading on "Channel 3" in the "VPB software" installed on the htRIXS PC (above).
- **Switch** between low-energy and high-energy optics is done by manually rotating the rotatable feedthrough shown in Figure 2. GENTALLY rotate BOTH the feedthroughs until they reach the CW/CCW hardware limits for using the Low-Energy/High-Energy optics.

- Andor CCD arm rotation:



As of 2016/03/02, the CCD arm rotation of htRIXS spectrograph is operated through the hand drill, and the dial indicator touching the bottom of the Dialer (see image above)

Important NOTE: No-body touches the dial indicator! Otherwise, all the numbers for the focusing position bellow needs to be recalibrated and reset!

A Routine Procedure to Start RIXS experiments in iRXIS:

a. Move the sample to the marked positions on the *FrontDown* and *RearDown* camera screens (the 2 right side hanging screens in Figure 1).
b. Set the the calibrated parameters –NOTE: set the values shown ***in purple*** below.
c. Turn off lightening, cover all viewports, Open the valve to the spectrometer.
d. Move ***Y-axis*** to get the elastic peak to the known CCD channel.
e. Start RIXS measurements!

NOTE: The CCD arm angle determines the energy window & elastic peak position. You could use any recorded elastic peak position, e.g., from the "previous" experiment/sample.

➔ The values on CCD arm and elastic peak bellow only serves as one example!

Below is the operation parameters (check the values in purple)***:***

High-throughput RIXS (ht-RIXS) spectrograph

- (Fixed) htRIXS Andor CCD translation: -10 ~ -11mm
- (Fixed) Optical lid angle: ~ 20.8º (**do NOT adjust spectrometer struts!**)

Low Energy Optics:

LEG LVDT reading: 30559 (manual adjustment, Figure 2)

LEM LVDT reading: 33275 (picomotor adjustment through VPB software)

0th order: CCD Arm Angle (angle meter): about ***24º***

1st order: CCD Arm Angle (angle meter): about ***20.8º***

[***Example!***] With CCD arm *Dialer at 1.845 mm*, move Y-axis so the ***180 eV*** elastic peak is at *CCD channel 585*. Further fine adjustment to maximize the intensity is recommended.

High Energy Optics:

HEG LVDT reading: 18485 (manual adjustment, Figure 2)

HEM LVDT reading: 32415 (picomotor adjustment through VPB software)

1st order: CCD arm angle (angle meter): about **21º**

0th order: CCD arm angle (angle miter): about **22.8º**

[***Example!***] With CCD arm at the lowest possible position: 710 eV elastic peak @ channel 578

High-resolution RIXS (hr-RIXS) spectrograph

Note: All necessary user-level adjustments of hr-RIXS are motorized. Do not "manually" move any part of hr-RIXS, especially the struts, unless you clearly understand what you are doing!

0th order centered on CCD:

Elements	Encoder counts
Grating	8540
Premirror	0
Spec rotation	-430000
CCD translation	0 (non-sensitive)
Lower aperture	25 – 18 (half) mm
Upper aperture	0 – 9 (half) mm

1st order measurement positions:

Grating	***0***
Premirror	***0***
[Examples:]	
Spec rotation	-245000 (with Fe-L and O-K range centered)
Spec rotation	-230358 (600 eV at 955 channel)
Spec rotation	-270988 (O-K to Ni-L on screen) O-K fluorescence (NOT elastic) peak at about #159 channel!

NOTE: Elastic peak position in hrRIXS spectrograph is insensitive to the Y-axis motion. So just focus on getting the highest peak intensity and the experiment could start.

Important End-of-run Operations!!

- In Andor CCD software, TURN OFF the cooling of CCD !
- Close the valve(s) to the spectrograph
- Exit the VPB software for picomotor/LVDT controls
- Other typical practices, e.g., close valves to beamline, etc.

Spectrograph Operation Software

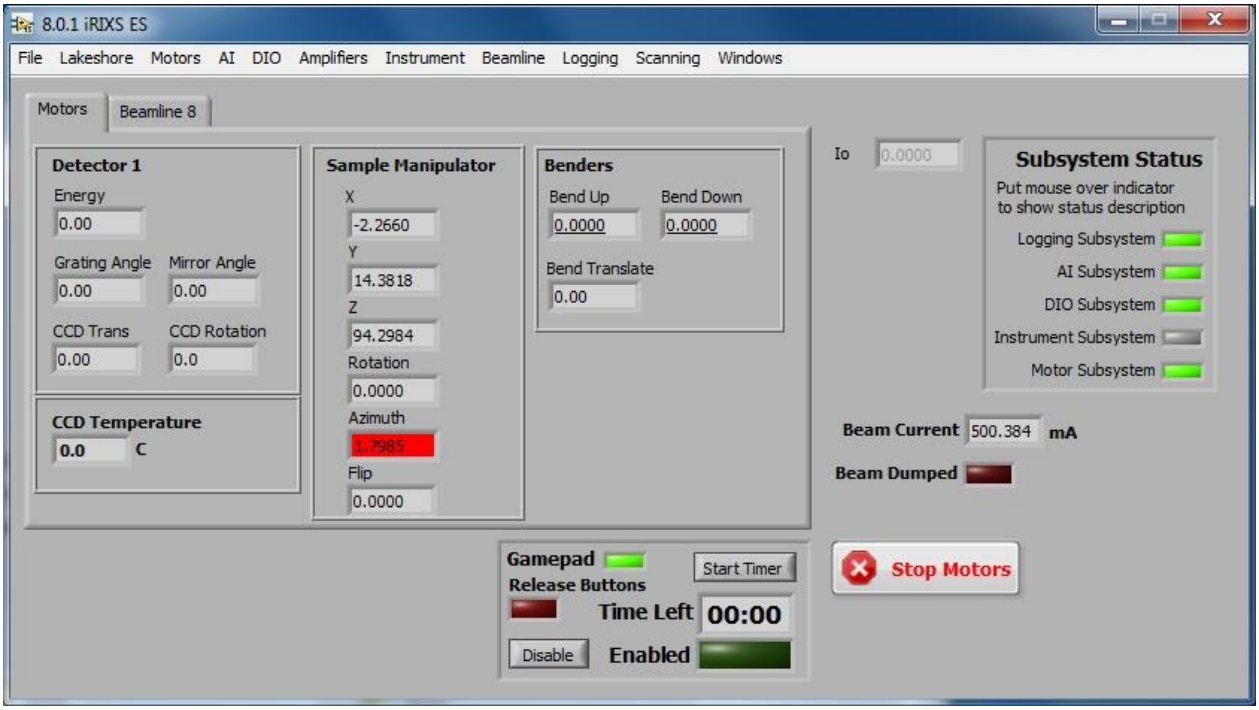
There are 3 software packages for collecting the data through Andor CCD:

1. The Andor Solis camera software from Andor
2. The ALS Labview software by the ALS software group
3. The software package developed over the last many years by ***Prof. Clemens Heske, Dr. Oliver Fuchs, Dr. Lothar Weinhardt, Dr. Monika Blum*** and other members in their group. (Runs with 32 bits Labview!)

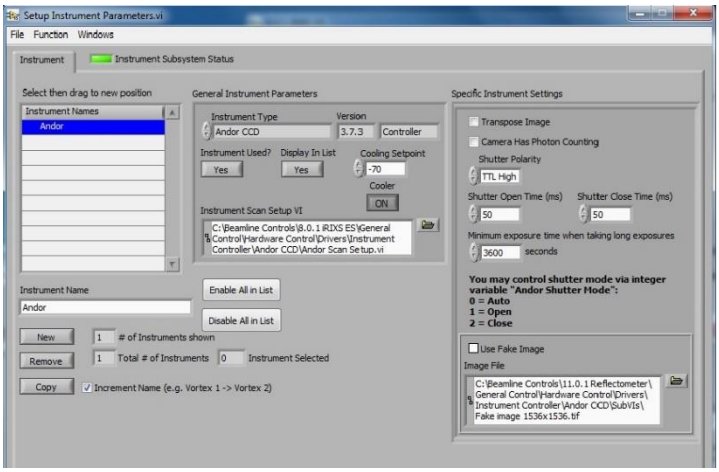
At this time, the 3rd software package is the most user friendly software.

2. *The ALS Labview Software (under development):*

On iRIXS PC (see Figure 1), run the main iRIXS BCS software. You will see the standard ALS control interface window:



Select “Instrument” – “Set Parameters”. The window below pops up:

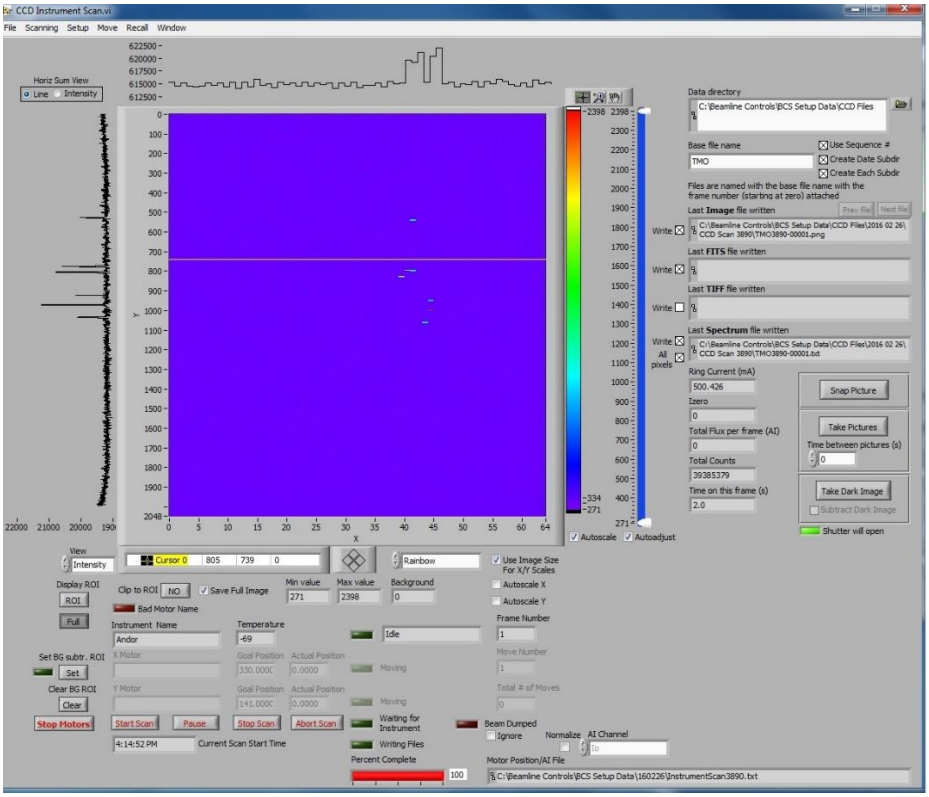


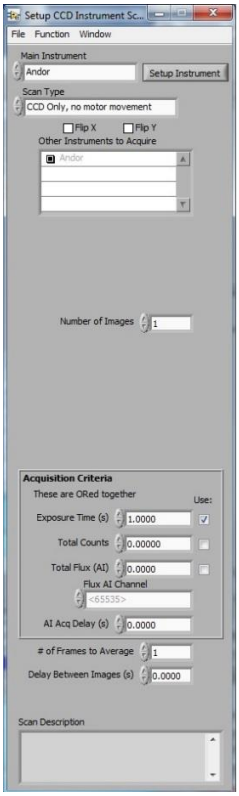
Under “Cooler” on this panel, Click to turn “ON” the cooler.

Choose from manual “Function” – “Save” !

<u>Note:</u> Change has to be “save”d, otherwise the cooler will be off once you quit this window!

Now, back to the main BCS control panel and select “Scanning” – “CCD instrument Scan”. Two panels will pop up as below, left is the main CCD image window, right is the scan setup window that could also be opened through the image window manual.

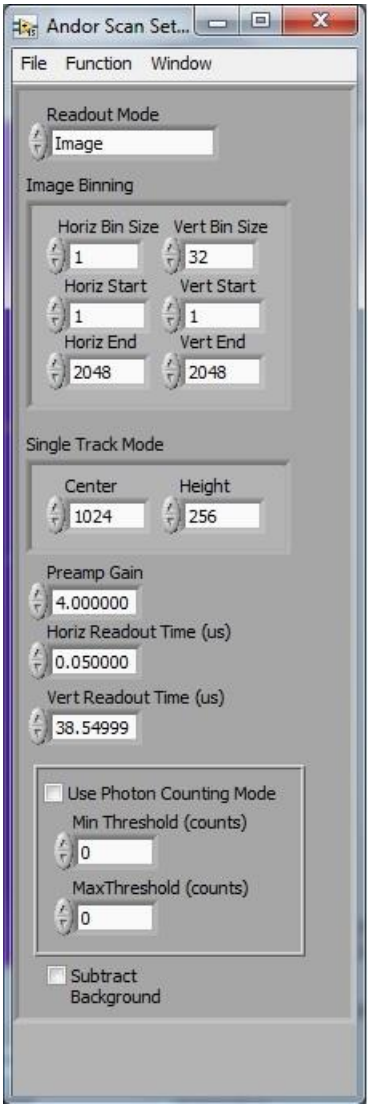




Now, wait until the “temperature” of the CCD shows -70 or lower on the main image window.

Note: Try not to turn on the CCD until the temperature is low, except for occasional checking. If the CCD shows high background when it is cooled down, it may need to be warm up and cooled down again.

Click on the “setup instrument” of the scan setup window. Set the parameters as in the image below, especially on the *gain* and *readout time*.



Now you should be ready for collecting data!